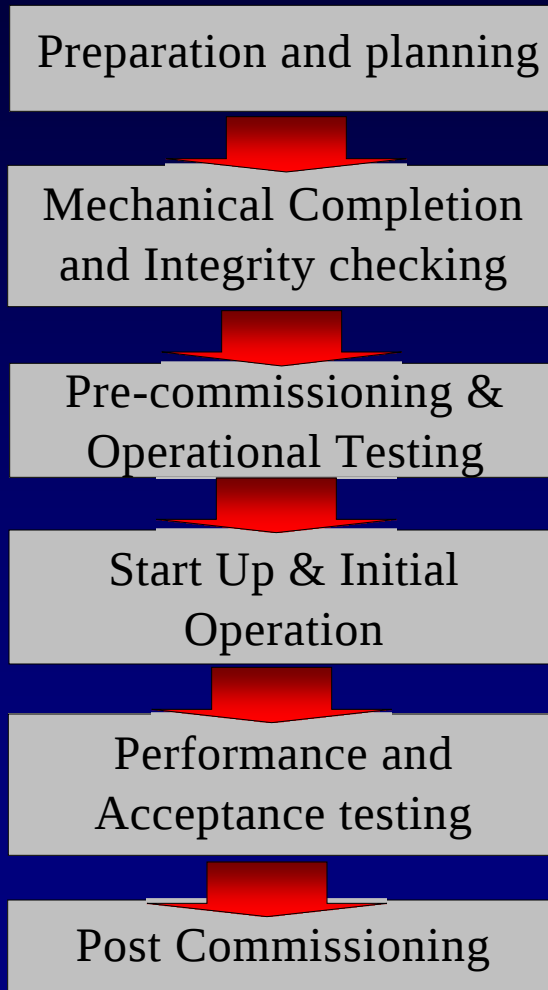


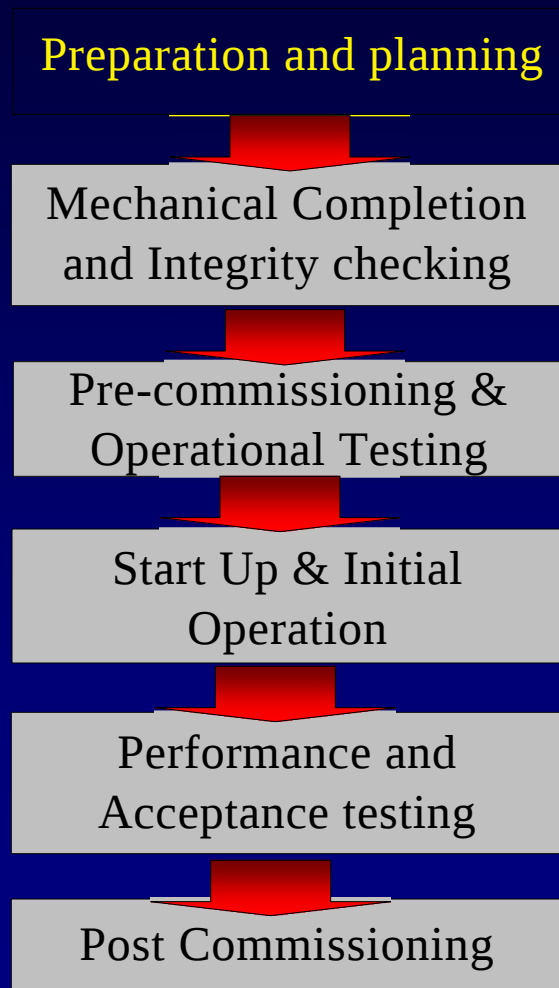
Plant commissioning & start up procedure

The Commissioning Process

Key Stages



The Commissioning Process Detail - 1



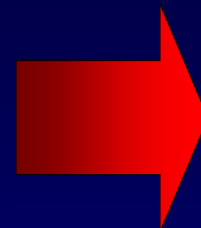
- Appointment of Commissioning Manager or Lead Commissioning Engineer;
- Appointment of Commissioning Team Members and Support Staff;
- Training;
- Information Compilation;
- Safety and Risk Assessment;
- ***Commissioning Strategy Development;***
- ***Procedures and Checklist Development;***
- Detailed Plan and Budget Preparation;

Commissioning Strategy

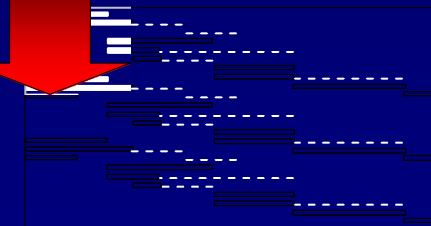
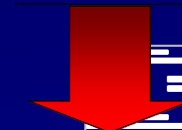
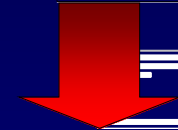
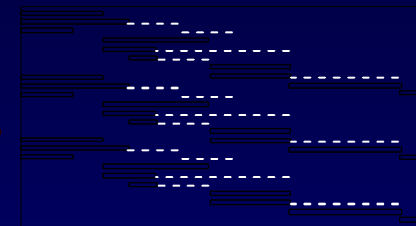
Commissioning
Strategy



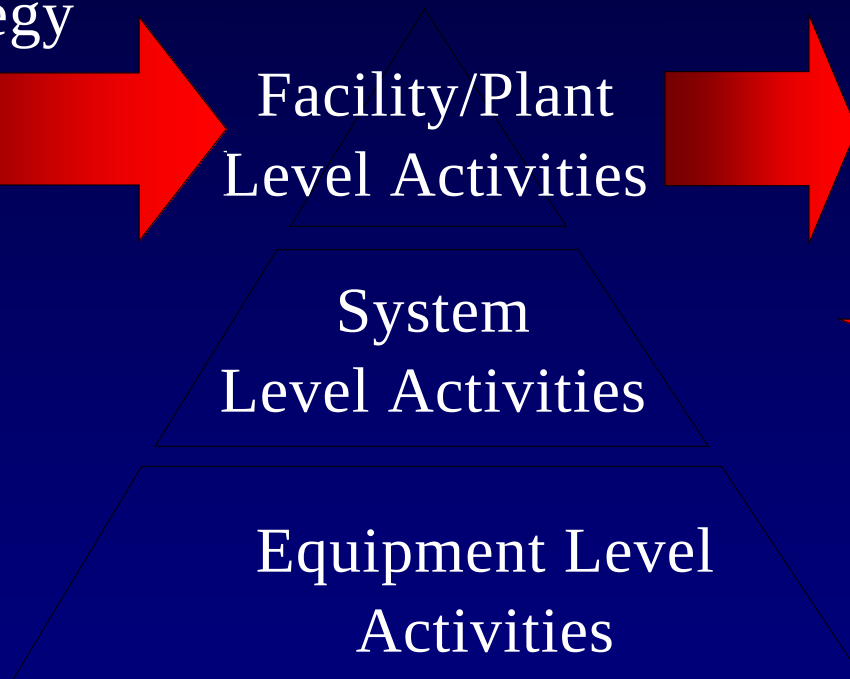
Facility/Plant
Level Activities



Commissioning Master Plan



Individual item commissioning
plans, procedures and checklists



Facility Commissioning Issues

- Time phasing construction and commissioning activities
- Time phasing the commissioning of the various parts of the plant relative to each other;
- Relationships and timings determining when various systems need to be available:
 - Electrical, Steam, Water, Instrumentation
- Sequencing of the overall plant startup and shutdown to ensure we do not create unsafe conditions;
- Initial start up;
- Process Control and Shutdown;
- Performance testing;

Developing Startup Procedures

- Engineering and construction companies generally follow a systematic procedure where by their startup engineers review the process design several times as it is developed;
- After the first review, a preliminary start-up and operations procedure is written;
- Decide what must be added to the design to make the process capable of being started up and operated;
- By the time the final engineering flow-sheets have been released a complete startup and operating instructions manual should have been completed.

Issues considered

- Are various part of the process too depend on one another;
- Is there enough surge capacity;
- Are there provisions to prevent abnormal pressures, temperatures and rates of reaction;
- Where are additional valves and bypass lines needed;
- Special lines to allow equipment to be started up and rerun product/raw materials.

System Level Activities

- Utilities systems - steam, instrument air, process water, fire water, drainage, condensate return;
- Electrical systems;
- Instrumentation and instrumentation systems;
- Cleaning and flushing;
- Purging;
- Initial start up and shutdowns;
- Performance testing;

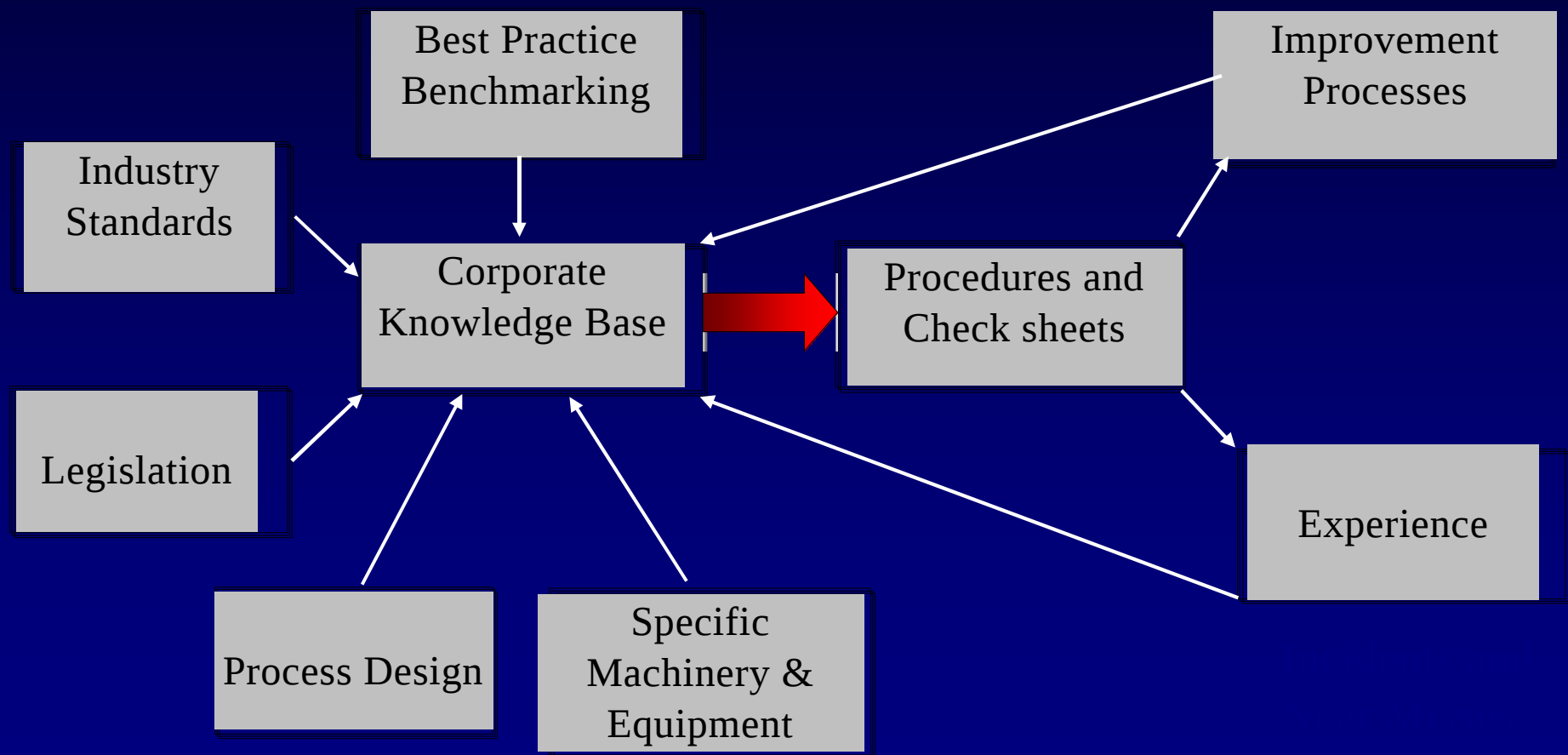
Equipment Level Activities

- Pressure testing & mechanical integrity testing of vessel, columns and pipe work;
- Heat Exchangers, condensers, coolers etc.
- Mechanical equipment and machinery;
- Control Systems and Instrumentation;
- Operational testing;
- Proof testing and acceptance.

What can be done before mechanical completion

- Utilities commissioning
- Lube and Seal-Oil Systems Cleaned
- Instrumentation and Control Loops Proven
- Piping, Towers and Vessels Cleaned
- Boil-Out, Dry-Out and Acid Cleaning
- Turbine, Motor and Pump Run-Ins
- Nitrogen Purge and Tightness Testing

Building Organisational Learning



Procedures

- Procedures are written routines/instructions that describe the logical sequence of activities required to perform a work process and the specific actions required to perform each activity;
- If there are no written procedures, there is no basis for monitoring performance, focus for improvement or mechanism by which to capture learning;
- The establishment of procedures and routines allow more time and mental energy to deal with the unexpected, which always happen during commissioning.

Commissioning/Startup Logic

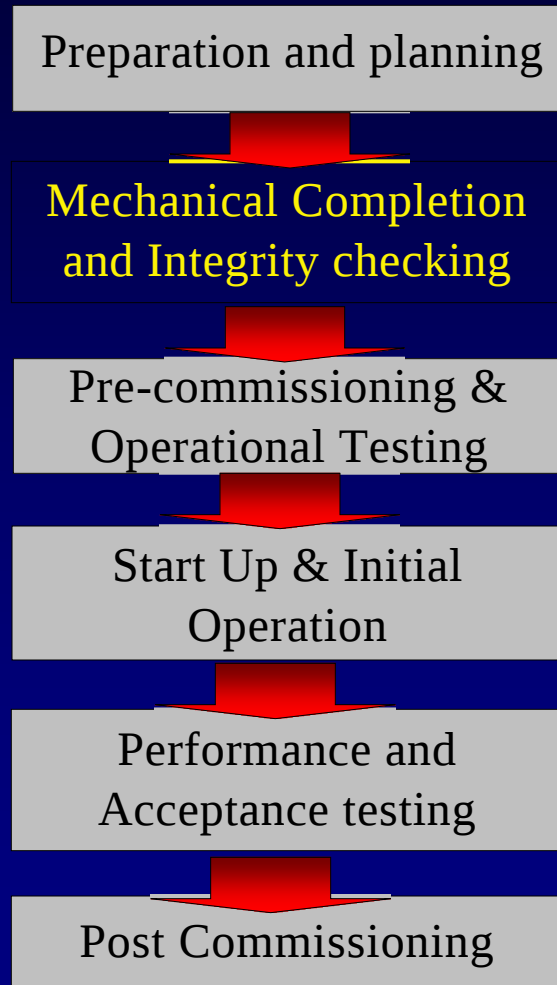
- A Critical Path Network (Plan) with written procedures with related documents are required. These should define for the facility, each plant system:
 - The order in which the systems will be started up;
 - Individual activities at each stage;
 - Operation testing requirements;
 - Durations, waiting times, cooling times;
 - Total duration for starting up each system;
 - Resources required - labour, materials, equipment, services;
 - Temperatures, pressures, fluid flows used.

Commissioning/Startup and Shutdown Issues

- At the facility, system and equipment level, we want to avoid:
 - Creation/existence of explosive mixtures, usually because of the presence of air;
 - Water hammer and water based explosion effects, due to contact between water and hot substances (steam, oil, etc.);
- In particular, during commissioning hot fluids and gases will be coming into contact with cold surfaces in places that would be hot under normal operations.

Mechanical Completion and Integrity Checking

Mechanical Completion and Integrity Inspection



- Inspection
- Pressure testing
- Cleaning and Flushing
- Machinery checkout

Categories of Process Equipment

- Distillation Towers/Fractionation Towers
- Reboilers & Other Shell & Tube Heat Exchangers
- Boilers and Fired Heaters
- Pressure Vessels and Pipe-work
- Fin-Fan Coolers
- Condensers
- Machinery/Rotating Equipment
- Valves
- Instrumentation
- Electrical Equipment

Machinery/ Rotating Equipment

- Pumps
- Steam Turbines
- Gas Turbines
- Compressors
- Gas Engines
- Electric Motors

Mechanical Completion and Integrity Inspection

- Involves checking that everything has been built and it there as per specification. Refer:
 - Piping Plan Drawings;
 - Layout and construction drawings;
 - P & ID's
- Electrical systems, Instrumentation and control systems checkout down by appropriately qualified personnel (Electricians and Instrumentation technicians).
 - General commissioning engineers generally do not get involved in this in a hands-on manner.

Mechanical Completion and Integrity Inspection Procedure

- Divide plant into manageable areas;
 - In a large plant, assign individuals or teams to specific areas;
- Establish a master set of piping plan drawings and P&ID's, mark up areas:
- Individual commissioning engineers or teams walk every line and mark up every item that can be confirmed as present on master set of drawings;
- Use different coloured “highlighter” pens to indicate different services.

Mechanical Completion and Integrity Inspection

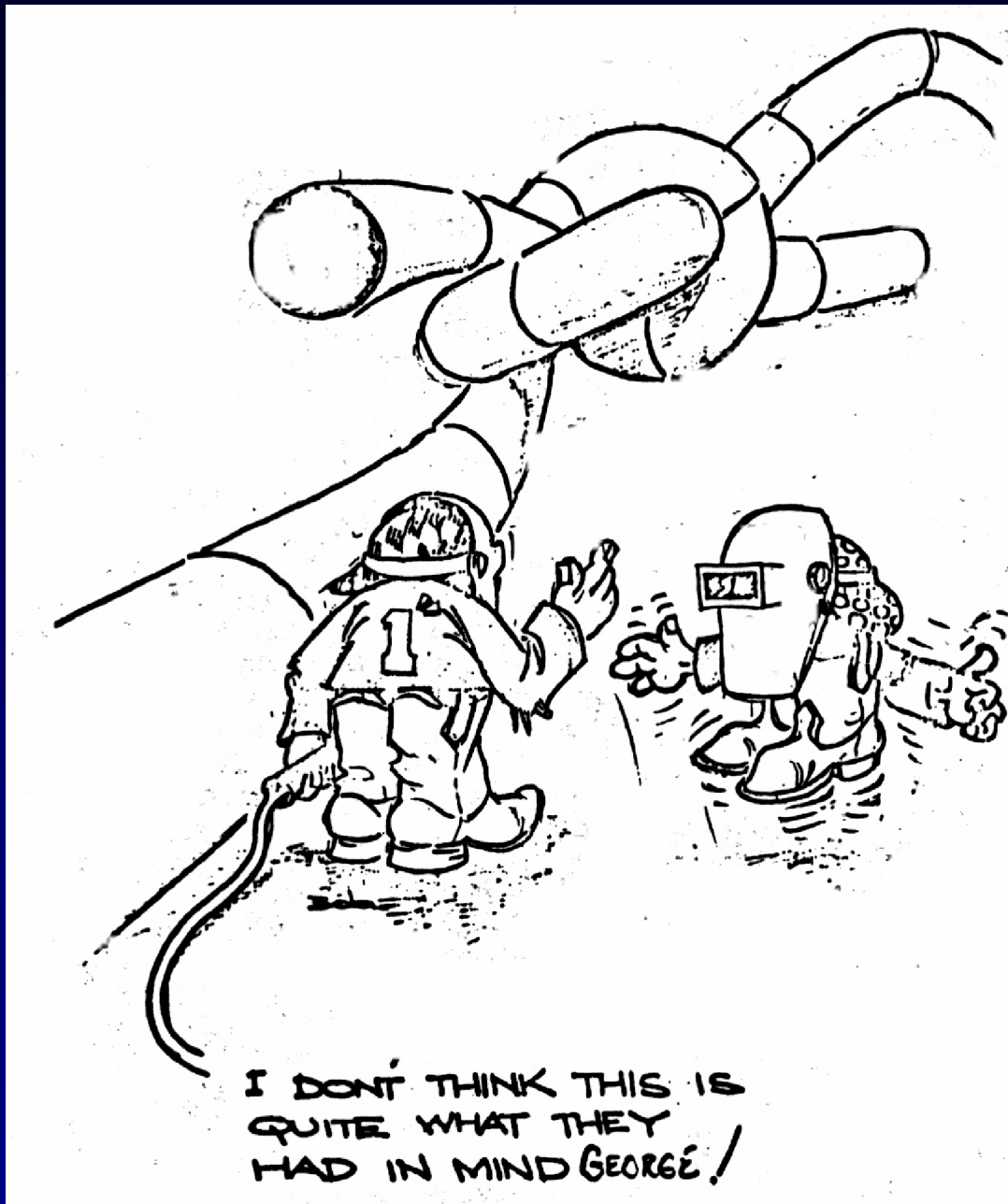
Every line must be walked! Physically sight everything!



Mechanical Completion and Integrity Inspection Procedure - Hints/Tips

- Ensure pipes, vessels, valves etc. are all in the right place;
- Valves are correct type - globe, gate, control;
- Vents, drains, steam traps etc.
- Flanges, bolts, types of bolts;
- Blind flanges and swingable blinds in place, correct rating;
- Check all tag numbers;
- Punchlist any non-conformances.

New Plant Piping Tie-ins!



Pipe Stressing

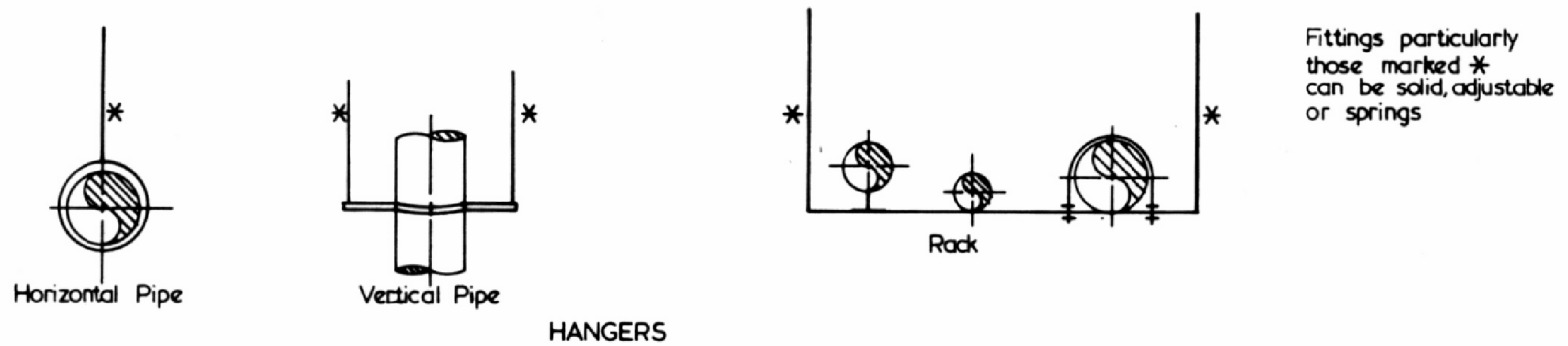
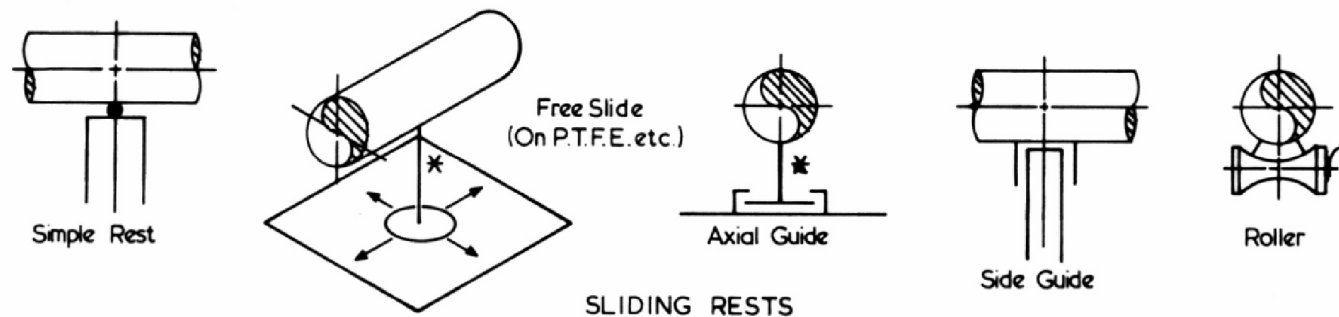
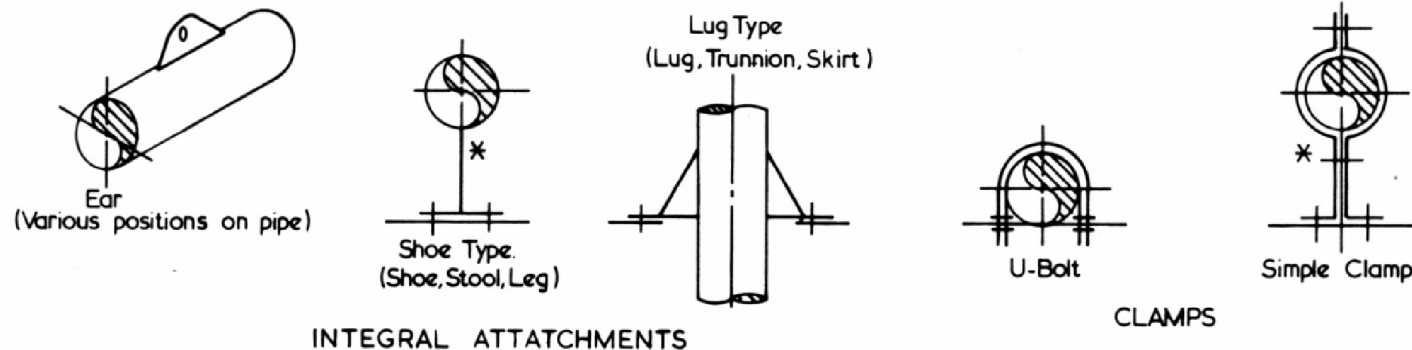
- Piping should provide adequately for expansion and contraction due to temperature changes, without placing excessive stresses on equipment;
- Misalignment between matching flanges on pipe-work - particular where there are changes in direction (elbows) can cause stressing;
- Misalignments where pipe-work connects to machinery, vessels and other process equipment;
- Can often be seen visually, or checked with gauges using the same procedures we use to align rotating equipment.

Piping and Equipment Supports

Piping and equipment supports

- Mobile supports permit and guide the thermal growth of equipment undergoing temperature change;
- If they do not function correctly, vessels, equipment, pipe work, nozzles heat exchangers etc. may be damaged.

Typical piping support methods



Piping and equipment supports

- Inspection prior to start up:
 - Check that installed according to specification and not jammed;
- Inspection during warm up:
 - Check thermal growth is occurring and supports are responding as per design;
 - Check that there is no surface buckling or crimping - this needs to be corrected;
 - Check expansion joints;
 - Check long straight runs of piping for bowing or support shoes that may have slipped;
 - *Rule of thumb - bowing is excessive if you can see it.*

Piping and equipment supports

- Inspection after cool-down:
 - Check that sliding supports have returned to original positions;
 - Establish that equipment can expand and contract as required.

Inspection of spring supports

- Before hydro-testing:
 - Check that spring stops are installed. (If not, the weight of water in pipe will deform the spring).
- After hydro-testing but before heating:
 - Check that stops are removed;
 - Check that spring pointer is positioned to cold setting;

Inspection of spring supports

- During and at end of heating:
 - Check pointer has not exceeded hot setting;
- After cool down:
 - check to establish piping can expand and contract as required;
 - establish that springs can absorb loads.

Vessels and Columns

Inspection of Vessels and Columns

- The inspection of vessels, columns and reactors should be scheduled to be completed before construction has closed them up;
- Other inspections - e.g. for completeness or piping, insulation, safety etc. can be scheduled later;
- If a vessel has been sealed up by construction, it is your duty to inspect it, even if construction resists.

Inspection of Vessels and Columns

- Check that distributors have been installed correctly;
- De-misters installed correctly and of correct materials, design, type;
- Vortex breakers in place;
- Trays - packed or “bubble-cap” are correct:
 - Bubble caps not jammed or damaged, down comers clear, supports all OK.

Pressure Testing

Pressure Testing - Objectives

- The objective of pressure testing is to confirm the mechanical integrity of the plant;
- Verifying capability of containing the pressures it has been designed to hold;
- Ensure there are no leaks and verify that the plant can be reliably made leak free;
- Identify any vulnerabilities well before the plant is placed into service;
- Meet the requirements of legislation, local, international and industry standards.

Pressure Testing - responsibilities

- Pressure tests of tanks, reactors and piping for mechanical strength and tightness of joints is usually done by the construction team;
- Commissioning team representatives should witness and certify the tests;
- Need to verify that all necessary safety precautions have been taken;

Pressure Testing - procedures

- Water for testing and flushing should contain a rust inhibitor - one low in chloride content for stainless steel lines;
- After testing, water should be drained completely from all lines that do not normally carry water, steam or steam condensate;
- All low points should be checked for presence of water;
- Lines should be dried by blowing hot air, dry inert gas or instrument air.

Pressure Testing - Vacuum Systems

- Final checks of vacuum systems are best performed by pulling a vacuum and observing the rate of pressure rise in the blocked in system;
- Excessive leaks can then be located by applying a mild positive pressure and testing each flange with bubble solution.

Pressure Testing - Procedures 2

- Isometric drawings of all systems to be tested should be displayed on a board and marked up as each section is tested;
- Hydrotesting of piping and equipment according to code requirements to confirm mechanical strength should be carried out on groups of equipment naturally suggested by design pressure and function;
- All water, steam, condensate, oil, gas and process steam piping should be hydrotested;
- Major equipment that has already been tested as part of manufacturing may be isolated by blanks.

Cleaning and Flushing

Cleaning and Flushing

- Need to ensure no construction debris is left in pipes of vessels - welding rods, bolts, gloves, rags etc.
- Large debris (lumber, cable, packaging) should have been removed during mechanical integrity inspections;
- Small debris (rags, nuts, dirt) must be flushed out of all pipe and vessels;
- Where oil coatings must be removed, chemical cleaning is necessary.

Cleaning and Flushing

- Before flushing is started, check the process thoroughly to ensure:
 - Screens have been installed in front of pump suctions;
 - Blinds in front of equipment such as compressors and turbines;
 - “Jumper” spool pieces to allow for continuity of flow.

Flushing

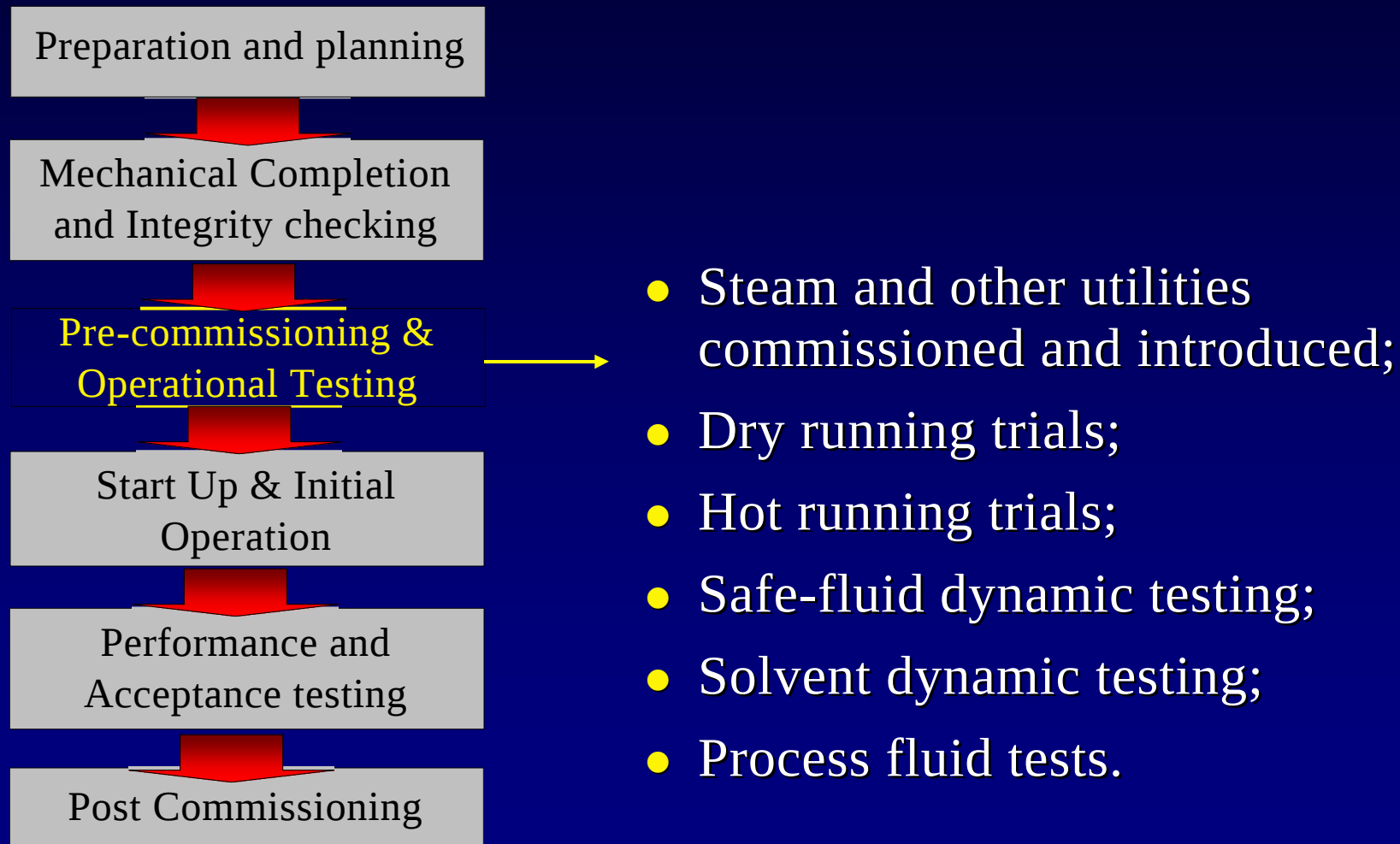
- Can be handled by geographic plant area;
- Sections too large for water flushing:
 - Pipes greater than 30 in diameter (0.75 m), or
 - Pipes that should not be touched with water;
- Should all be blown out with air or inert gas.

Flushing

- Regardless of whether pipes are cleaned with water, steam, air or nitrogen, flow velocities should be high enough to ensure that pipes will be suitably scoured;
- Need to ensure that the debris from one piece of equipment will not simply be flushed into another;
- Water velocities should be at least 12 ft/sec (approx. 3.75 m/sec);
- Air velocities a minimum of 200 ft/sec (approx. 65 m/sec);

Pre-commissioning and Operational Testing

The Commissioning Process Detail - 3



Commissioning Utilities

Commissioning Utilities

- Utilities commissioning usually represents the first phase of commissioning, as these usually need to be operational first, before the rest of the plant can be commissioned;
- The steps for commissioning each utility should be planned in detail;
- Provides planning practice for planning the startup of the main plant.

Commissioning Utilities - Broad Guidelines

- Check supply pressures of all services - steam, cooling water, instrument air, nitrogen etc.
- At the most distant points, open drains, vent valves or pipe flanges and purge until fluids come out clean and rust free;
- Purge/blow out lines to each piece of equipment;
- Check that instrument air is clean and dry, and at correct pressure;
- Circulate water to waste water system until water lines clear and clean;
- Flush waste water and drain systems to ensure no blockages;
- Check operation of steam traps;
- Drain condensate to waste water until it is clean.

Commissioning Utilities

Introducing Steam

- Steam usually represents the first “hazardous” fluid introduced into the “new” system;
- Admit steam slowly into the distribution system with atmospheric bleeds open:
 - Cold pipes will condense steam in places where it would not under normal operation;
 - Can lead to “water hammer” - can distort and rupture lines;
- After system has been warmed, slowly raise pressure and blow down the system with traps bypassed, until clean;
- Then place steam traps into service and check operation.

High Pressure Steam Systems

Specific Issues

- The cleanliness and purity of high pressure steam systems - particularly where the steam is used to drive a steam turbine should be checked by use of a “target”;
- For new boilers, or new sections added to steam system - blow down at full pressure;
- When steam appears clean, fit a target with a “mirrored” surface (ie. Small steel plate which has been polished, so that it is in the steam blow down stream;
- Blow down the boiler or system so that the target is impinged upon for a few minutes;
- Check target - ensure there are no small “pock marks” left on the target. If pock marked - repeat process.

Electrical Systems

Commissioning Electrical Systems

The following checks are typical of what is required

- Open circuit breakers and switches;
- Check that all bus-bars are free of dirt and foreign matter;
- Check grounding systems for continuity and resistance. Make sure all electrical equipment, vessels, structures are connected to the grounding system in accordance with drawings and specifications;
- Check that all sealed fittings are filled with proper sealants, all explosion proof, vapour-tight, dust-tight and weather tight enclosures are properly closed and secured;
- Check motor control and power circuitry for correct hookup.

Commissioning Electrical Systems - 2

The following checks are typical of what is required

- Check all nameplates and panel directories to ensure that each circuit breaker and switch does control the proper circuit. Label all switches even though their application may seem obvious;
- Close main transformer primary disconnect switch and switch-gear main circuit breaker;
- Check voltmeter at switch-gear for proper voltage;
- Close first switch-gear circuit breaker, second, third etc.
- Close first motor control centre main circuit breaker, then each motor starter circuit breaker. Repeat for each MCC.
- Check overload breakers and heaters to ensure that the correct capacity units have been installed.

Commissioning Electrical Systems - 3

The following checks are typical of what is required

- Check that all lighting and power circuits are functioning correctly;
- Check motor bearings for proper lubrication;
- Remove motor power fuses and check main contractor, interlock and sequencing devices;
- Uncouple each motor, replace fuses and check direction of rotation by momentarily pressing the start button, then stop;
 - Check manual, then automatic operation.
- Replace all couplings, check drive belts and make sure guards are installed.

Electric motor driven pumps



Operational Testing

Operational Testing

- Progresses through several stages;
- Dry runs of individual items of equipment
- Hot testing of individual items of equipment and systems;
- Several stages of Dynamic Testing of:
 - Individual items of equipment;
 - Individual Systems/processes in isolation;
 - The whole new process plant installation.

Dry runs and Hot Tests

- Check that motors are connected correctly and turn in the right direction;
- Shafts and impellers move freely;
- Equipment that is to be operated at temperature, raise to temperature and check;
- These tests should be performed by the manufacturer's representative but witnessed by members of the client's operating/commissioning personnel.

Hot testing equipment

- Applies to equipment whose leak-tightness must be tested at operating temperatures and after temperature reversals;
- Fixed-bed catalytic reactors that in normal conditions are heated by heat transfer fluids where leakage would contaminate the catalyst;
- Critical exchangers whose steam or cooling water is at a high pressure than the process fluid;
- Any equipment having complicated seals through which leakage could occur;
- Rotating machinery which must be able to rotate freely at temperature eg. Steam turbines, etc.

Hot testing procedures

- The thermal shock tolerance of equipment must be determined beforehand;
- To avoid thermal shock, the temperature of the heating medium may have to be raised gradually;
- Time required for a hot test must be established in advance;
- Establish a uniform temperature in all parts of equipment that are supposed to be uniformly hot during operation to avoid setting up stresses;

Dynamic Testing

Dynamic Testing

- Involves operating the equipment, before introducing “live” process fluid;
- During dynamic testing, we progress through:
 - Safe-fluid dynamic testing;
 - Dynamic testing with solvent;
 - Closed loop testing with process fluid.
- Once process fluid is introduced, normal plant safety procedures must come into effect as if it were a live operating plant.

Safe-Fluid Dynamic Testing

- Closed loop dynamic testing with safe fluids consists of operating equipment systems with air, water, inert gases etc.
- This permits flow testing of equipment;
- Gives first indication of how control loops work;
- Establishes performance while there is still time to modify the plant;
- Familiarises operators with the operation of the equipment before hazardous materials are introduced;
- Gets rid of a lot of dirt which would be more difficult to clear once the process fluid has been introduced.

General Principles for Testing

- For most plants, a period of 2-3 weeks is usually sufficient for operational testing, after the mechanical dry running of individual pieces of equipment and hot testing complete;
- Air and water tests should be set up in a closed loop with fluids continuously recycled, with loops as large as possible;
- The loop should ideally be the same loop that will be subject to solvent testing;
- Tests should continue for several days in order to give all shifts a chance to conduct the same tests;
- All shifts should be given the opportunity to start up and shutdown each closed loop test.

General Principles for Testing

- A rough flow-sheet should be developed for air and water tests, predicting all information that normally appears on a process flow sheet - flow, temperature, pressure, heat transfer, power etc.
 - will assist in alerting commissioning team to risks from over-pressuring, overloading, temperature-shocking and stressing equipment;

Cautions during Testing

- Dynamic testing may lead to:
 - Unusual or unforeseen differential expansions;
 - Corrosion;
 - Excessive weight of liquid into parts of the system;
- Care must be taken not to collapse or burst pressure vessels and tanks:
 - ensure there is always adequate venting;
 - avoid pulling a vacuum.

Dynamic Testing - Simulated Operations

Safe Fluid Testing

- Auxiliary services must be brought into operation first:
 - water cooling, inert gas generators, boiler feedwater, firewater, steam production, etc.
- Water is pumped through the process (except where special conditions do not permit it) and boiled up in columns;
- Compressors and blowers should be operated on air or inert gas.

The Value of Dynamic Testing - Simulated Operations

- Value of simulated operations will be to allow operator to become familiar with the operation of the process, before hazardous fluids are introduced;
- Equipment deficiencies can become apparent during dynamic testing;
- Failures and problems more easily corrected with safe fluids present
- Leaks should be found and tightened;
- Instruments can be placed into service - although selection of set-points will have to be deferred;
- Inspect the plant for evidence of design and construction errors.

Dynamic Testing - Simulated Operations

- At the end of the simulation, water should be drained - equipment dried and purged;
- Depending on the process - drying may not be necessary - but purging will always be required;

Dynamic testing with a solvent

- After safe fluid testing and subsequent repairs and modifications, we are ready for dynamic closed loop testing with a solvent;
- The “solvent” is a relatively safe fluid whose properties are close to that of the process fluid, or the process fluid itself;
- In order to allow for continuous re-circulation of the solvent and the use of different solvents in different parts of the plant, temporary lines will need to be installed.

Dynamic Testing with Process Solvent

- Introduce the process solvent. (if there is more than one, introduce only one at this stage);
- The dynamic testing procedure used for the safe fluid test is repeated for the process solvent dynamic testing;
- After operations with the first solvent have been brought completely under control, should the second solvent be introduced (if there is one).

Dynamic testing with a solvent

- The purpose of dynamic testing with a solvent is to check out equipment and instrument loops at, or near design conditions prior to the introduction of more hazardous process fluid;
- No reactions should be allowed to occur during these tests, so as to ensure that test fluids remain predictable in composition and properties;
- Guidelines used for safe-testing apply;
- Need to plan how solvent will be fed into the system and later removed.

Stages of dynamic testing with a “solvent”

- Drain safe fluid and purge air used in the previous test from the system;
- Dry out equipment where safe fluid was water. Check flow sheets for where water is likely to accumulate.
- Fill systems with the solvent. Ensure provisions made for venting and drains closed;
- When adequate levels established, place pumps and compressors online to complete filling;
- Start closed loop circulation;
- Heat up the systems to simulate operating conditions by placing reflux, reboiler and condensation systems into operation

Stages of dynamic testing with a “solvent”

- Systematically check out instrumentation and control loops;
- After instruments have checked out, place as many as possible on automatic control;
- All shifts should go through starting and stopping equipment, heating and cooling closed loop systems;
- Dynamic “solvent” testing offers the best opportunity for operator training before the “real thing”;
- Operate equipment as near as possible to design capacities;
- Reliability of emergency shutdown systems and alarms must be proven;
- Critical instruments must be calibrated over their full range.

Stages of dynamic testing with a “solvent”

- Deliberately operate equipment near its limits:
- Flood columns;
- Ease compressors into mild surges and plot surge curves;
- Overload condensers;
- Do not fear blowing a relief valve or two!
- After tests have been completed, plant should be ready for initial operation.

Closed Loop Dynamic Testing with Process Fluid

- Finally, introduce process fluid;
- During this step, instruments should be calibrated to cover their full range of flow, temperature and pressure;
- Ensure that instruments, process analysers and safety devices are kept work properly during these processes;
- After operations with process fluid are brought completely under control should the final stage of start-up be attempted.

Preparing to introduce process fluids

- Before introducing hazardous liquids into the plant, we complete additional pressure testing and purging;
- Need to check that the stresses and strains of dynamic testing has not caused any leaks - these must be found and fixed;

Pressure testing and purging

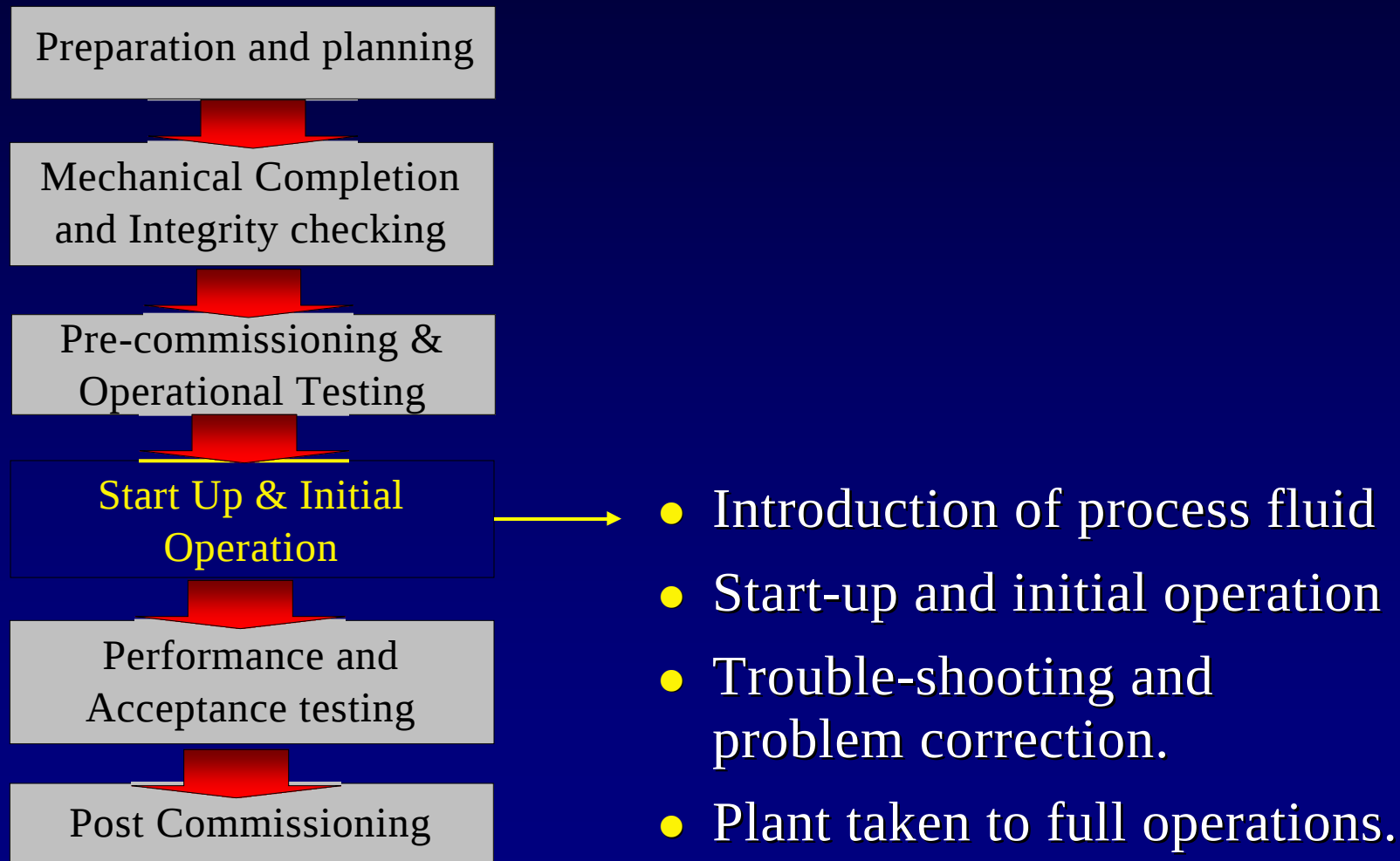
- Consists of pressuring and de-pressuring with nitrogen several times, until at least $<3\%$ oxygen is reached;
- Vacuum systems should be evacuated and then re-pressured with nitrogen;
- Long runs of piping are swept with nitrogen;
- While under pressure, rate of pressure loss of the “blocked in” system is monitored as a check for leaks and that no vents or drains have been left open.

Dehydrating by Circulation

- It is usually not possible to water-free equipment simply by draining;
- Only positive method to water-free process equipment is oil circulation followed by repeated draining of low points;
- Ensure sufficient low point drains are provided on piping, control valve loops, vessels and process machinery;
- Startup lines - deliver oil to upper part (trays) of distillation towers (size for 20% of net distillate product rate);

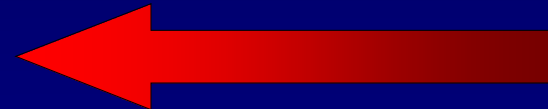
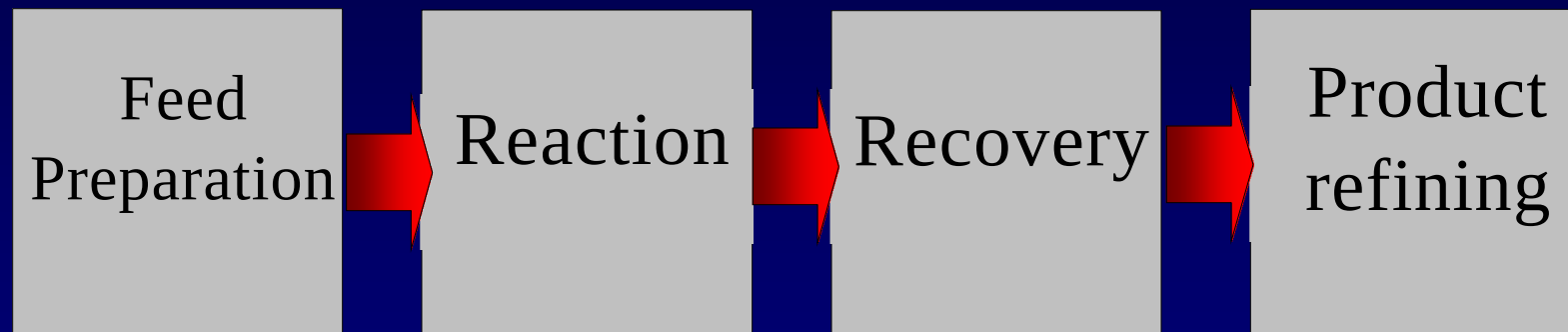
Start Up and Initial Operation

Start Up and Initial Operation



Starting Up the Plant

- Most plants in petrochemical/chemical industry have the following “general” form.



- Start Up from the End of the Process and Work back

Start Up Logic

- It is common practice to buy in product and start up the last part of the process first and work backwards to the front. E.g.
 - Start up refining, get this working and in control;
 - Then possibly start up reaction and recovery;
 - Finally, feed preparation.

Into the initial operation

- Once raw materials are fed into the plant - usually at reduced rate until reaction conditions have been established;
- As each section is started up, establish as quickly as possible that process conditions are as expected;
- If potentially serious problems develop, there should be no hesitation on going into an emergency shutdown.

Ramping up the plant

- Plant is brought slowly to design feed-rates and operating conditions;
- Usually done in steps with operating data evaluated and verified as OK at each step;
- Plant and laboratory data are now being collected and should be being evaluated promptly;

Coordination and Supervision during start up

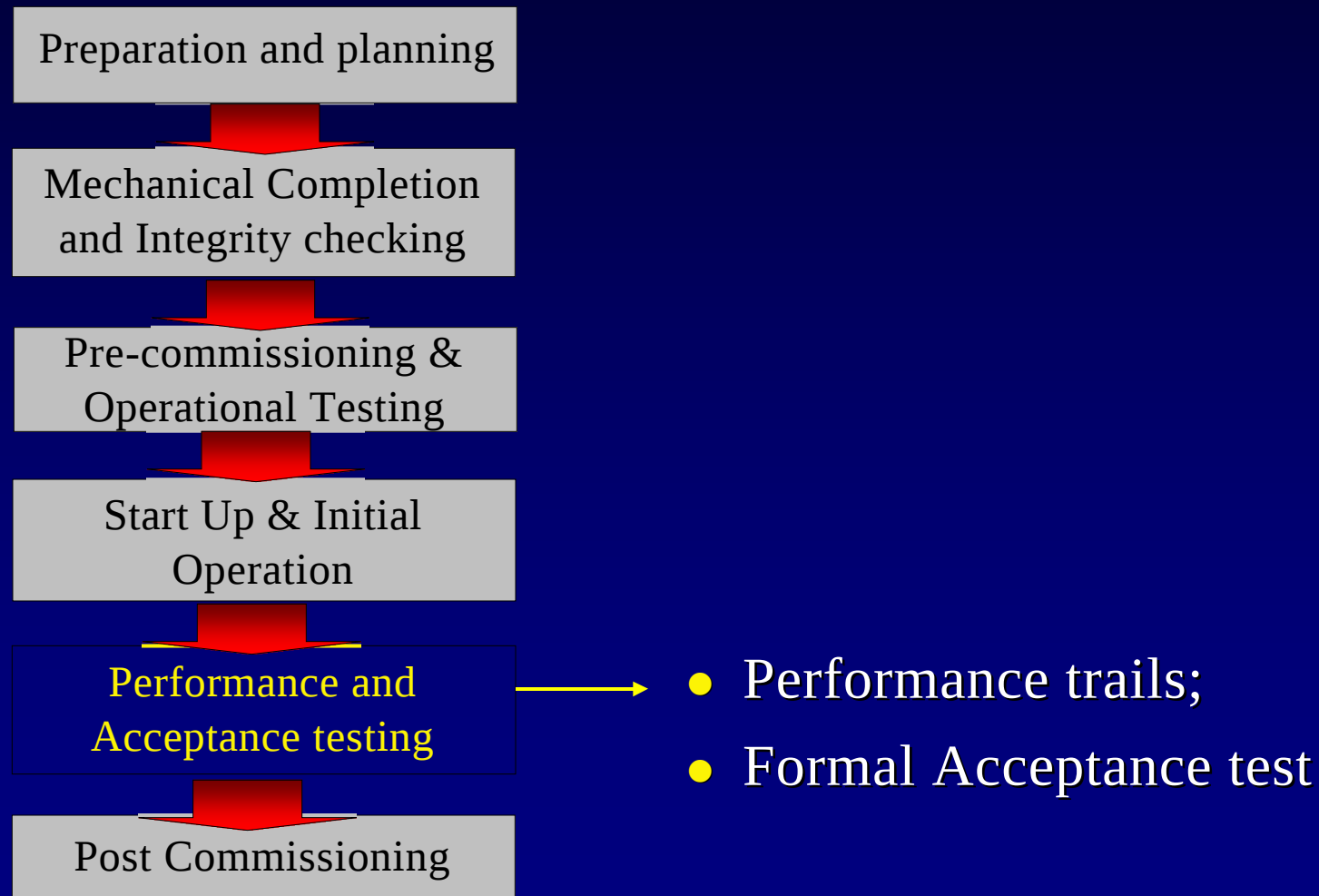
- Additional personnel, both supervisory and “on-the-ground” are required at this stage;
- Cooperation between startup personnel and plant supervisory personnel is critical at this stage:
 - Need a daily meeting at least;
 - Often, a briefing each shift.

Trouble Shooting

- At this stage, many problem with equipment of the process itself may become apparent;
- The commissioning process goes through what is often an intense (and hopefully short) period of problem trouble shooting, problem solving, engineering correction and plant modification;

Performance and Acceptance Trails

Performance and Acceptance Testing



The Performance Trails

- Once the plant is fully operational, the final “proving trail” or performance run is performed in order to prove the plant can do what it is supposed to do;
- The values or range of values for each independent variable - flow, temperature, pressure, level, concentrations, etc. to which the plant must be operated to are determined;
- The plant is brought up to those conditions and the pre-agreed trial period begins.

Before the trial or performance run need to ensure that...

- Control of plant operating conditions has been achieved. I.e. temperature, pressures, levels and analyses are reasonably constant or in the case of a batch process, there is repeatability;
- Daily material and energy balanced can be performed and that these agree with “official” production figures;
- Product specifications are being achieved consistently.

Need to verify

- Physical operation, capability and capacity of plant and equipment;
- Energy and mass balance;
- Process chemistry;
- Efficiencies, yields and quality;
- All to specification.

Acceptance

- When the plant has met the Performance and Acceptance test requirements designed by the commissioning team there is usually a formal acceptance process involving signing of acceptance certificates;
- Once the plant is accepted it is officially part of the normal operations - the responsibility of operations and maintenance;
- Commissioning is officially over;
- There may still be outstanding punchlist items

Acceptance Testing

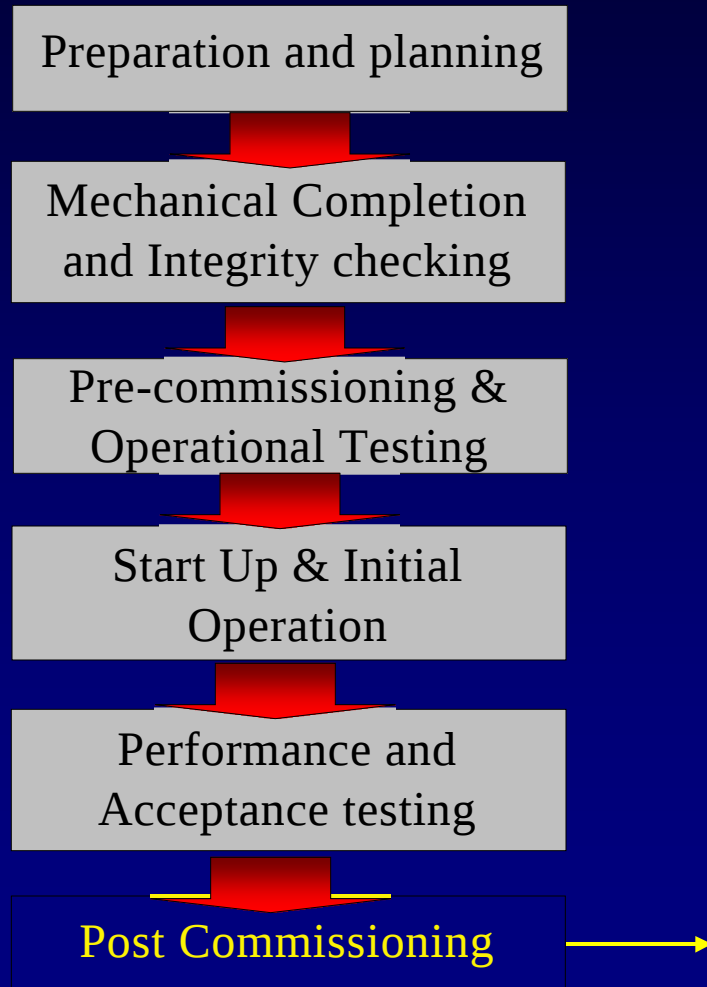
- It is common practice to prove performance repeatability and plant integrity as part of the performance test. That is:
 - Shutdown and Start Up the plant on several occasions and bring it up to test conditions to prove repeatability. Also ramp down and ramp up while online;
 - Re-inspection of critical process equipment - particularly columns to ensure they have not been damaged by the performance run.

Commercial Significant of Acceptance

- Formal Acceptance represents formal acknowledgment that the
 - Contractor has full-filled their contractual obligations;
 - Commissioning team have full-filled their obligations;
- Completion of the Capital Project and transfer to Operations;
- Expenses and costs from acceptance onwards are now operating expenses not capital project costs;
- All subject to agreed punch-list items.

Post-Commissioning

Post Commissioning



- From plant on-stream to settled down and in regular production;
- Adjustments, modifications and fault correction;
- Completion of outstanding punchlist items

Post Commissioning

- Covers the period immediately after Acceptance;
- Outstanding punch-list items are completed;
- The first routine maintenance checks are performed, findings evaluated and reported;
- Process equipment and items covered by warranty are scrutinized for signs of premature wear-out or problems;
- Operating data is collected and evaluated to ensure consistent plant operations are maintained and sustainable.